SYNERGY3D

Geothermal Heat Pumps with Water Heating for Radiant Floor Applications
- 3 thru 6 Ton

Synergy3D Installation Manual

Installation Information

Water Piping Connections

Electrical Connections

Startup Procedures

Preventive Maintenance

ARI Standard 13256-1

WaterFurnace

Smarter from the Ground Up™

IM1602 04/08

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SYNERGY3D

Model Nomenclature

S	D	V	049	A	1	1	1	N	T	L

Model Type
S= Synergy3D Dual Capacity

Compressor Type
D= Daul Capacity

Cabinet Configuration
V= Vertical

Unit Capacity

Vintage
A= Vintage

Voltage
1= 208/230/60/1

Return Air Configuration
L= Left
R= Right

Discharge Air Configuration
T= Top

Coax Options
C= Copper
N= Cupronickel

Fan Option
1= ECM
2= Oversized ECM Blower Option (038 & 049)

Hot Water Option
0= None
1= Hot Water Generation with factory installed pump

General Installation Information

Safety Considerations

Installation and servicing of heating and air conditioning equipment can be hazardous due to system pressure and electrical components. Only trained and qualified service personnel should install, repair or service heating and air conditioning equipment.

Untrained personnel can perform basic maintenance functions of cleaning coils and cleaning and replacing filters. All other operations should be performed by trained service personnel. When working on air conditioning equipment, observe precautions in the literature, tags and labels attached to the unit and other safety precautions that may apply.

Follow all safety codes. Wear safety glasses and work gloves. Use quenching cloth for brazing operations. Have fire extinguisher available for all brazing operations.

WARNING: Before performing service or maintenance operations on the system, turn off main power switches to the unit. Turn off accessory heater power switch if applicable. Electrical shock could cause serious personal injury.

Moving and Storage

Move units in the normal "Up" orientation. Vertical units are not to be moved, but may be stored one upon another to a maximum height of two units. When the equipment is received, all items should be carefully checked against the bill of lading to be sure all crates and cartons have been received. Examine units for shipping damage, removing the units from the packaging if necessary. Units in question should also be internally inspected. If any damage is noted, the carrier should make the proper notation on the delivery receipt, acknowledging the damage.

Unit Location

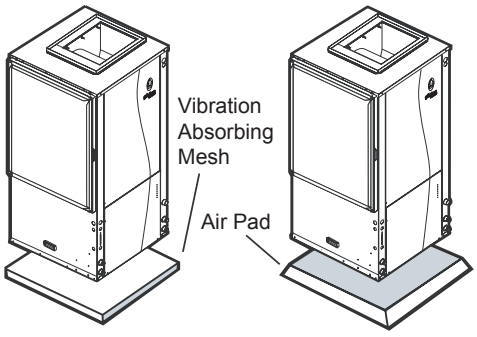
Locate the unit in an indoor area that allows easy removal of the filter and access panels, and has enough space for service personnel to perform maintenance or repair. Provide sufficient room to make water, electrical and duct connection(s). If the unit is located in a confined space, such as a closet, provisions must be made for return air to freely enter the space by means of a louvered door, etc. Care should be taken when units are located in unconditioned spaces to prevent damage from frozen water lines and excessive heat that could damage electrical components.

CAUTION: A minimum of 24-inch clearance should be allowed for access to front access panel.

Setting Vertical Units

Vertical units are available in left or right hand return configuration. Vertical units should be mounted level on a vibration absorbing pad slightly larger than the base to provide isolation between the unit and the floor. It is not necessary to anchor the unit to the floor (See Figure 1).

Figure 1: Vertical Unit Mounting



Duct System

An air outlet collar is provided on vertical top flow units to facilitate a duct connection, which is shipped inside the unit. A flexible connector is recommended for discharge and return air duct connections on metal duct systems. Uninsulated duct should be insulated with a minimum of 1-inch duct insulation. Application of the unit to uninsulated ductwork in an unconditioned space is not recommended as the unit's performance will be adversely affected.

If the unit is connected to existing ductwork, a previous check should have been made to assure that the duct has the capacity to handle the air required for the unit application. If ducting is too small, as in the replacement of heating only systems, larger ductwork should be installed. All existing ductwork should be checked for leaks and repaired when necessary.

The duct system should be sized to handle the design airflow quietly. To maximize sound attenuation of the unit blower, the supply and return plenums should include internal duct liner of glass fiber or be of ductboard construction for the first few feet. If air noise or excessive airflow is a problem, the blower speed can be changed. See the Blower Performance and Fan Speed sections on page 16.

General Installation Information (cont.)

Water Piping Connections

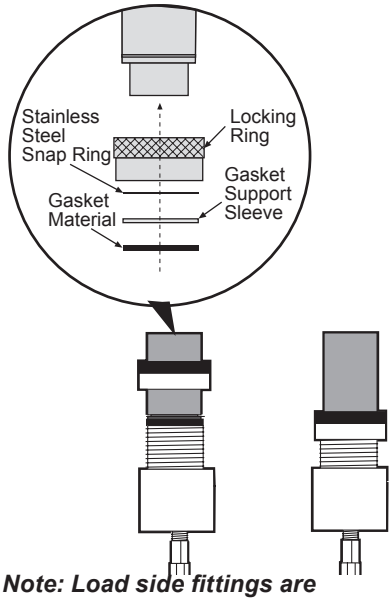
All Synergy3D source water connections are swivel piping fittings that accept a 1-inch Male Pipe Thread (MPT) (see Figure 2). The swivel pipe connector has a rubber gasket seal similar to a garden hose gasket, which when mated to the flush end of 1-inch threaded pipe provides a leak-free seal without the need for thread sealing tape or compound. Check to ensure that the rubber seal is in the swivel connector prior to attempting any connection. The rubber seals are shipped attached to the air coil inside the blower compartment.

To make the connection to a ground loop system, mate the brass connector (supplied in CK4L and CK4L-GL connector kits) against the rubber gasket in the swivel connector, and thread the female locking ring onto the pipe threads, while maintaining the brass connector in the desired direction (see Figure 2). Tighten the connectors by hand and then gently snug the fitting with pliers to provide a leak proof joint. When connecting to an open loop (ground water) system, thread 1-inch MPT fitting into the swivel connector and tighten in the same manner as noted above. The open and closed loop piping system must include pressure/temperature taps for serviceability.

Never use flexible hoses smaller than 1-inch inside diameter on the unit and limit hose length to 10 feet. per connection. Check carefully for water leaks.

CAUTION: Water piping exposed to outside temperature may be subject to freezing.

Figure 2: Female Locking Ring



Note: Load side fittings are same type as source.

Water Quality

In ground water situations where scaling could be heavy or where biological growth such as iron bacteria will be present, a closed loop system is recommended. The heat exchanger coils in ground water systems may, over a period of time, lose heat exchange capabilities due to a buildup of mineral deposits inside. These can be cleaned, but only by a qualified service mechanic, as special solutions and pumping equipment are required. Desuperheater coils can likewise become

Material		Copper	90/10 Cupro-Nickel
pH	**Acidity/Alkalinity**	7- 9	5 - 9
Scaling	Calcium and Magnesium Carbonate	(Total Hardness) less than 350 ppm	(Total Hardness) less than 350 ppm
Corrosion	Hydrogen Sulfide	Less than .5 ppm (rotten egg smell appears at 0.5 PPM)	10 - 50 ppm
	Sulfates	Less than 125 ppm	Less than 125 ppm
	Chlorine	Less than .5 ppm	Less than .5 ppm
	Chlorides	Less than 20 ppm	Less than125 ppm
	Carbon Dioxide	Less than 50 ppm	10 - 50 ppm
	Ammonia	Less than 2 ppm	Less than 2 ppm
	Ammonia Chloride	Less than .5 ppm	Less than .5 ppm
	Ammonia Nitrate	Less than .5 ppm	Less than .5 ppm
	Ammonia Hydroxide	Less than .5 ppm	Less than .5 ppm
	Ammonia Sulfate	Less than .5 ppm	Less than .5 ppm
	Total Dissolved Solids (TDS)	Less than 1000 ppm	1000-1500 ppm
Iron Fouling (Biological Growth)	Iron, Fe^{2}+ (Ferrous) Bacterial Iron Potential	None	None
	Iron Oxide	Less than 1 ppm. Above this level deposition will occur.	Less than 1 ppm. Above this level deposition will occur.
Erosion	Suspended Solids	Less than 10 ppm and filtered for max of 600 micron size	Less than 10 ppm and filtered for max of 600 micron size
	Threshold Velocity (Fresh Water)	5-8 ft/sec	8-12 ft/sec

Note: Grains = PPM divided by 17 • mg/l is equivalent to PPM

General Installation Information (cont.)

scaled and possibly plugged. In areas with extremely hard water, the owner should be informed that the heat exchanger may require occasional flushing.

Units with cupronickel heat exchangers are recommended for open loop applications due to the increased resistance to build-up and corrosion, along with reduced wear caused by acid cleaning.

Freeze Sensing

Set the freeze sensing switch SW2 #2 to “Loop” on the printed circuit board for applications using a closed loop anti-freeze solution. On applications using an open loop/ground water system, set to “Well” (the factory setting). If using closed loop and no antifreeze solution leave in “Well” position (the factory setting).

Condensate Drain

The internal condensate drain assembly consists of a drain tube, which is attached to the drain pan, a 3/4-inch PVC female adapter, and a flexible connecting hose. The female adapter may exit either the front or the side of the vertical cabinet. The adapter will be glued to the field-installed PVC condensate piping. A condensate hose is inside all cabinets as a trapping loop; therefore, an external trap is not necessary.

Air Coil

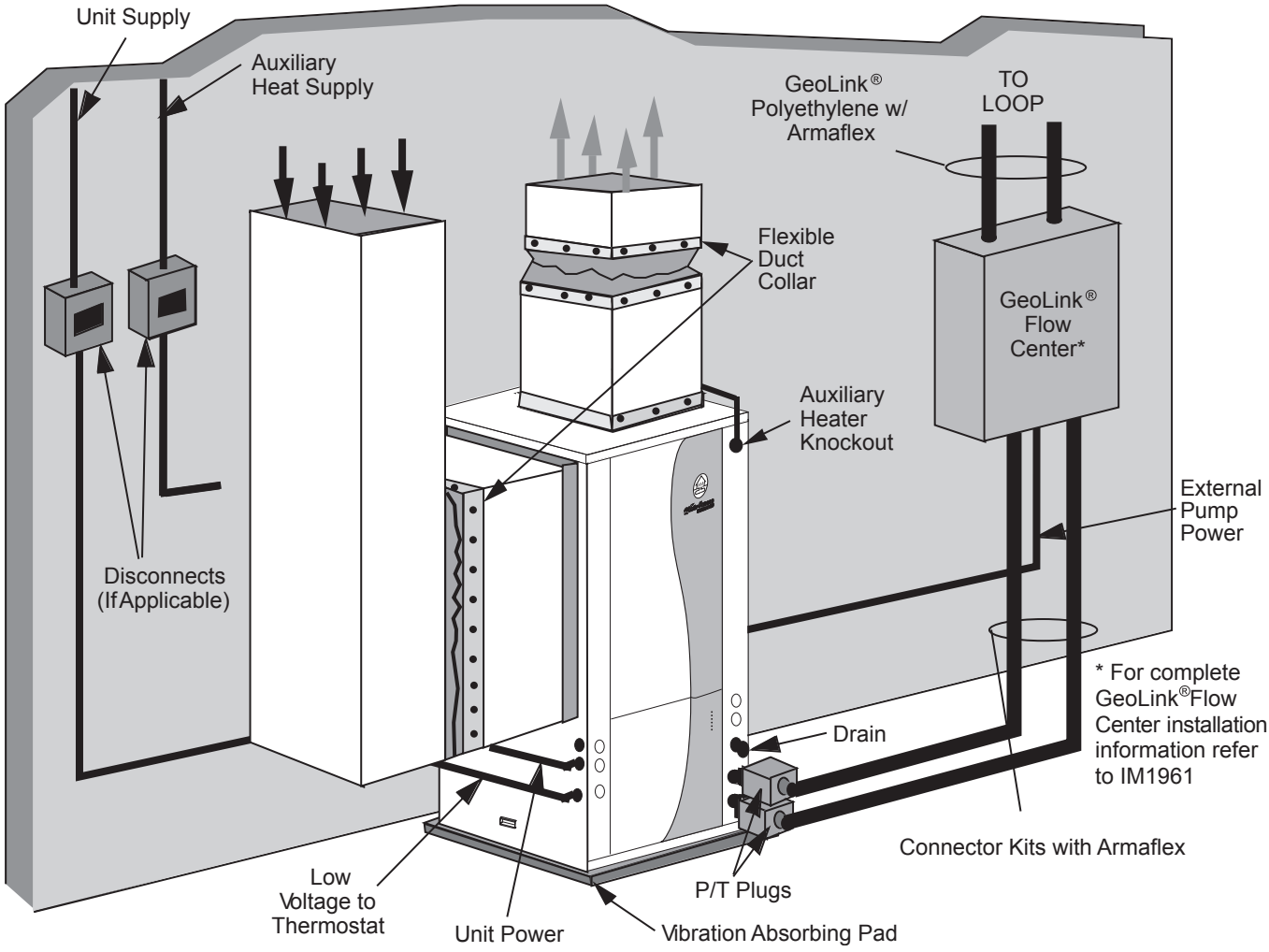
To obtain maximum performance the air coil should be cleaned before start up. A 10% solution of dishwasher detergent and water is recommended for both sides of coil; a thorough water rinse should follow.

Closed Loop Ground Source Systems

Once piping is completed between the unit, flow center and the ground loop (Figure 3), final purging and charging of the loop is needed. A flush cart (at least a 1.5 HP pump) is needed to achieve adequate flow velocity in the loop to purge air and dirt particles from the loop itself. Antifreeze solution is used in most areas to prevent freezing. Flush the system adequately to remove as much air as possible then pressurize the loop to a static pressure of 50-75 psi (winter) or 40-50 psi (summer). This is normally adequate for good system operation. Loop static pressure will fluctuate with the seasons. Pressures will be higher in the winter months than during the cooling season. This fluctuation is normal and should be considered when charging the system initially.

After pressurization, be sure to remove the plug in the end of the loop pump motor(s) (if Grundfos® pumps are used) to allow trapped air to be discharged and to ensure the motor housing has been flooded. Ensure the loop flow center provides adequate flow through the unit by checking pressure drop across the heat exchanger and comparing it to the figures shown in unit capacity tables in Specification Catalog SP1554. Usually 2.5-3 gpm of flow per ton of cooling capacity is recommended in earth loop applications. See wiring schematics on pages 10 and 11 for loop pump power wiring details.

Figure 3 - Closed Loop: Ground Source Application



Multiple Units on One Flow Center

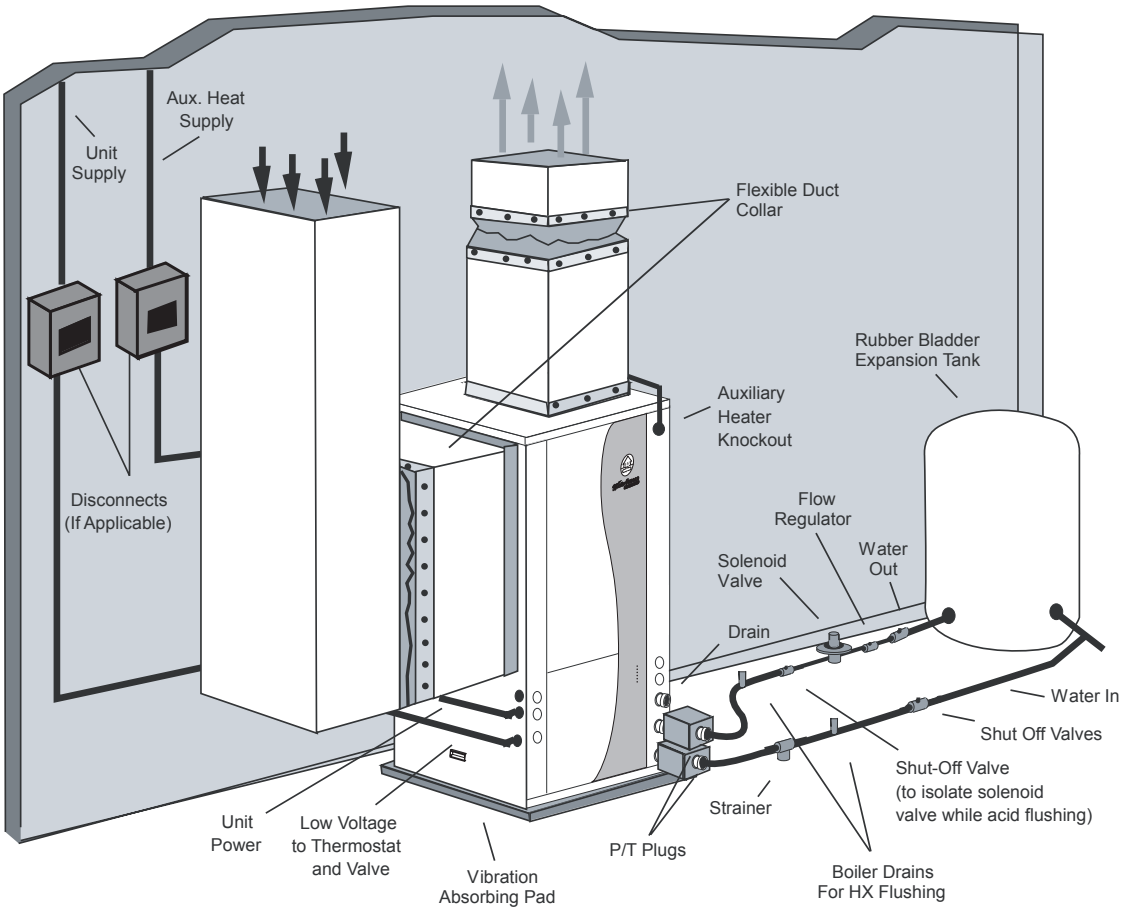
When two Synergy3D units or one Envision unit and one Synergy3D unit are connected to one loop pumping system, pump control is automatically achieved by connecting the slave terminals on connector P2 in both units with 2-wire thermostat wire. These terminals are polarity conscious (see Figure 5). The loop pump(s) may be powered from either unit, whichever is more convenient. If either unit calls, the loop pump(s) will automatically start.

Open Loop Ground Water Systems

Typical open loop piping is shown in Figure 5. Always maintain water pressure in the heat exchanger by placing water contraol valves at the outlet of hte unit to prevent mineral precipitation. Use a closed, bladder-type expansion tank to minimize mineral formation due to air exposure. Ensure proper water flow through the unit by checking pressure drip across the heat exchanger and comparing it to the figures in the pressure drop tables. Normally about 2 GPM flow rate per ton of cooling capacity (1.5 GPM per ton minimum at 50° F) is needed in open loop systems.

Discharge water from the unit is not contaminated in any manner and can be disposed of in various ways such as recharge well, storm sewer, drain field, adjacent stream or pond, etc.depending on local building codes. Most local codes forbid the use of sanitary sewer for disposal. Consult your local building and zoning department to ensure compliance in your area.

Figure 5 - Open System: Ground Water Application



Notes: For open loop ground water systems or systems that do not contain and antifreeze solution, set SW2-#2 to the “Well” position.

Figure 6: Open Loop Solenoid Valve Connection Option

Typical slow operating external 24V water solenoid valve (type VM) wiring.

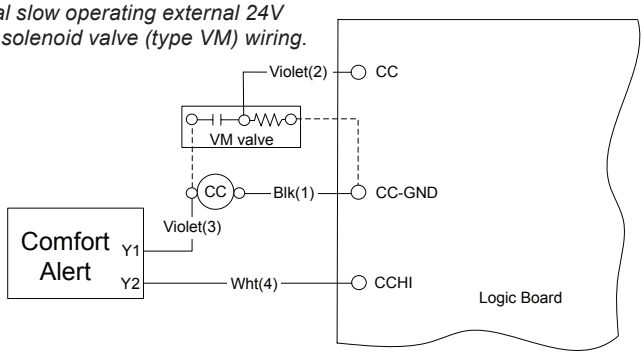
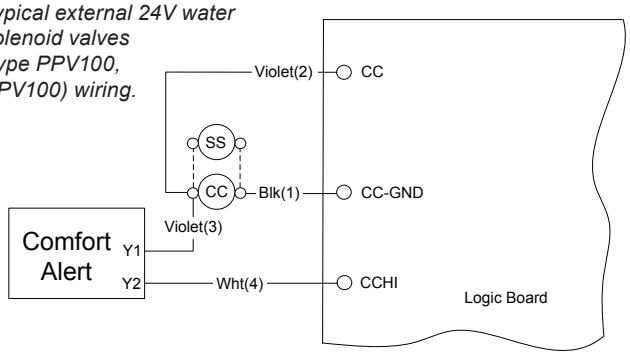


Figure 7: BPV or PPV Valve Wiring

Typical external 24V water solenoid valves (type PPV100, BPV100) wiring.

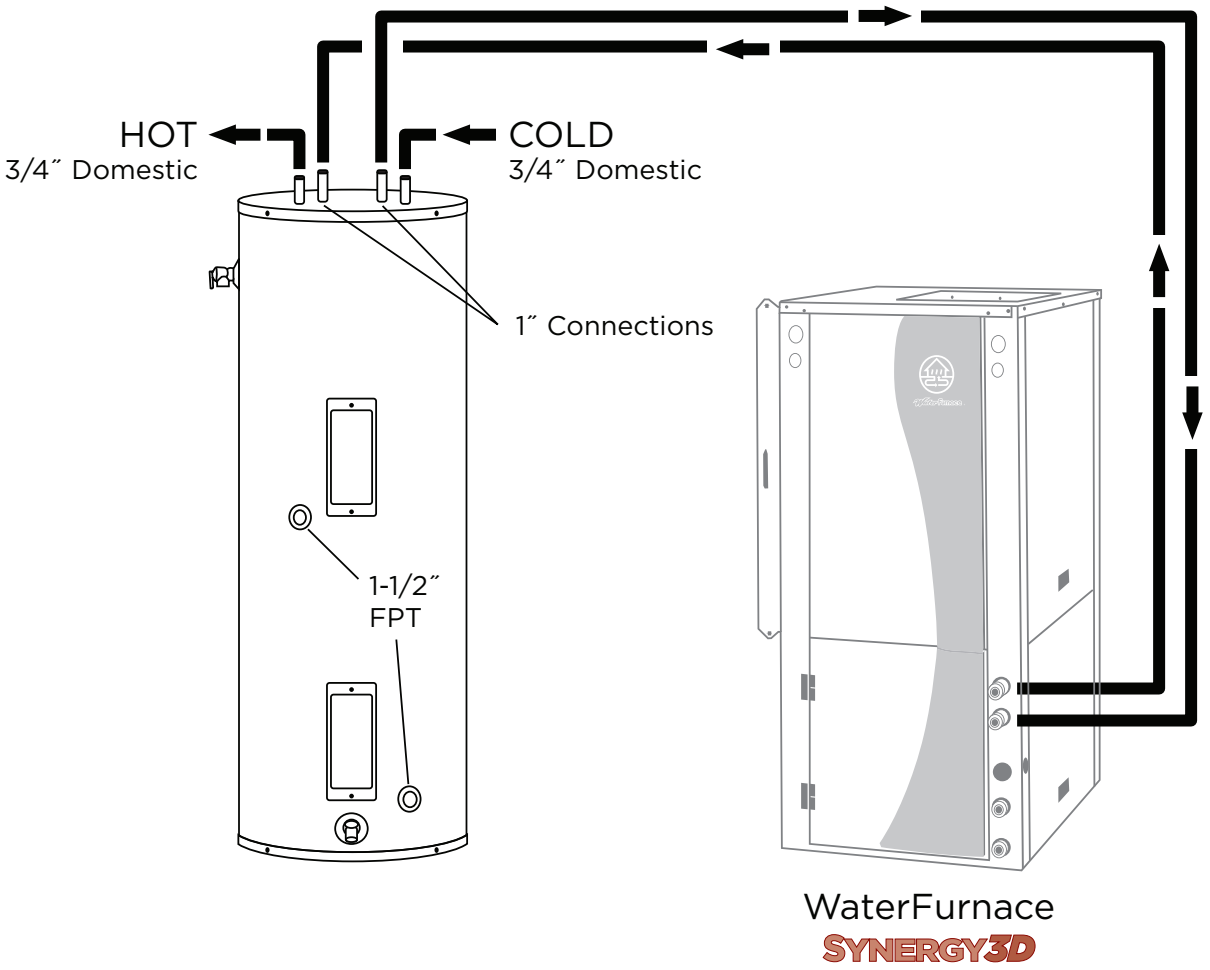


Desuperheater Connections

To maximize the benefits of the desuperheater a minimum 50-gallon water heater is recommended. For higher demand applications, use an 80-gallon water heater or two 50-gallon water heaters connected in a series as shown below. Electric water heaters are recommended. Make sure all local electrical and plumbing codes are met for installing a desuperheater. The Synergy3D is not supplied with an internal circulator. A DPK5 kit will need to be purchased to connect to the desuperheater. The DPK5 kit is supplied with installation instructions.

Typical Buffer Tank Installation

Figure 8: Synergy3D with Buffer Tank



Electrical

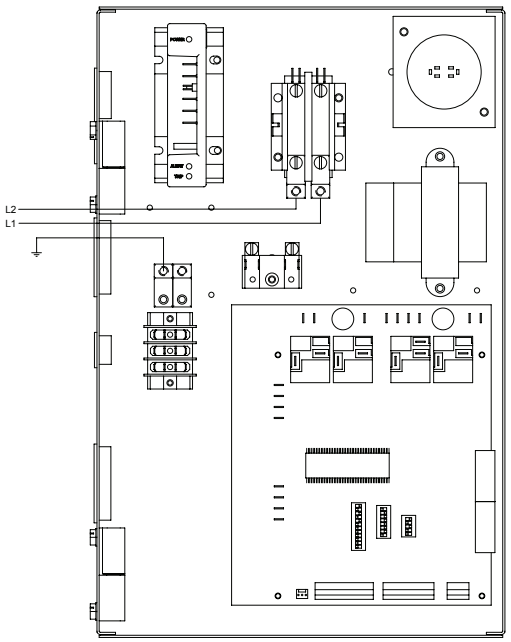
General

Be sure the available power is the same voltage and phase as that shown on the unit serial plate. Line and low voltage wiring must be done in accordance with local codes or the National Electric Code, whichever is applicable.

Unit Power Connection

Line Voltage connection is made by connecting the incoming line voltage wires to the “L” side of the contactor as shown in Figure 9. Consult the Unit Electrical Data table below for correct fuse size.

Figure 9: Synergy3D Line Voltage 208-230/60/1



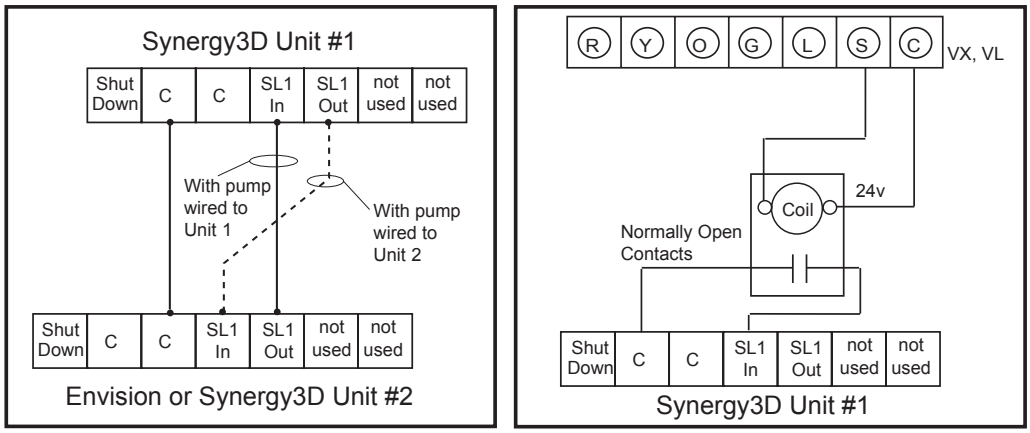
External Loop Pump Power Connection

If the unit is to be used with an external loop pump (FC1 or FC2 flow center), the pump(s) will be connected to the terminals on PB1 in the unit electrical box as shown in Figure 4. The pumps will automatically be cycled as required by the unit or by a secondary signal from another Synergy3D unit sharing the flow center. (Refer to the wiring schematic on page 10-11.)

208 Volt Operation

All 208-230 volt units are factory wired for 230 volt operation. For 2098 volt operation, the red and the blue transformer wires must be switched on terminal strip PS1. (Refer to wiring schematic on pages 10-11 for details.)

Figure 10: Wiring Multiple Units to One Flow Center



Electrical Data

Model	Rated Voltage	Voltage Min/Max	Compressor			Int Pump	Ext Loop	Fan Motor	Total Unit	Min Circ	Max Fuse	Max Fuse/
			MCC	RLA	LRA	FLA	FLA	FLA	FLA	Amp	calc	HACR
SDV038	208-230/60/1	197/254	26.0	16.6	82.0	1.75	5.4	4.0	27.8	31.9	48.5	45
SDV038*	208-230/60/1	197/254	26.0	16.6	82.0	1.75	5.4	7.0	30.8	34.9	51.5	50
SDV049	208-230/60/1	197/254	33.0	21.1	96.0	1.75	5.4	4.0	32.3	37.5	58.6	50
SDV049*	208-230/60/1	197/254	33.0	21.1	96.0	1.75	5.4	7.0	35.3	40.5	61.6	60
SDV064	208-230/60/1	197/254	40.0	25.6	118.0	1.75	5.4	7.0	39.8	46.2	71.8	70
SDV072	208-230/60/1	197/254	42.5	27.2	150.0	1.75	5.4	7.0	41.4	48.2	75.4	70

* With optional 1 HP ECM2 motor

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Rated Voltage of 208-230/60/1.

Min/Max Voltage of 197/254.

HACR circuit breaker in USA only.

All fuses Class RK-5.

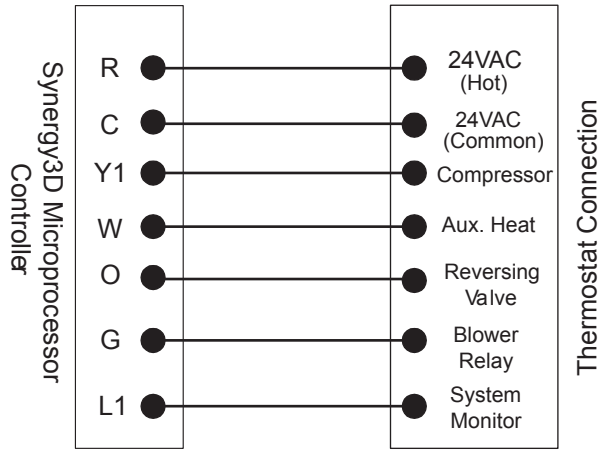
Local electrical codes overule any wiring recommendations.

Thermostat Installation

Installation

Position the thermostat subbase against the wall so that it is level and the thermostat wires protrude through the subbase. Mark the position of the subbase mounting holes and drill holes with a 3/16-inch bit. Install anchors and secure base to the wall. Thermostat wire must be 8 conductor 18 AWG wire. Strip the wires back 1/4-inch (longer strip lengths may cause shorts) and insert the thermostat wires into the Synergy3D connector as shown in Figure 11. Tighten the screws to ensure good connections. The thermostat has the same type of connectors, requiring the same wiring. See instructions enclosed in the thermostat for detailed installation and operation information.

Figure 11 - Thermostat Wiring



Other Thermostats

The Synergy3D unit is compatible with virtually any 24VAC thermostat. However, the multi-stage nature of this product requires a 3-stage heating/2-stage cooling type thermostat.

Note: DIP switch SW2-8 is required to be in the “OFF” position for the control to operate with FaultFlash or ComforTalk thermostats. SW2-8 in the “ON” position configures the control to operate with typical thermostats (continuous lockout signal). There must be a wire connecting Y2 on the microprocessor controller to 2nd stage compressor on the thermostat for proper operation.

Physical Data

Model	038	049	064	072
Compressor (1 each)	Copeland Scroll			
Factory Charge R410a, oz [kg]	90 [2.55]	95 [2.69]	124 [3.51]	128 [3.62]
ECM Fan Motor & Blower				
Fan Motor Type/Speeds	ECM Variable Speed			
Fan Motor- hp [W]	1/2 [373]	1/2 [373]	1 [746]	1 [746]
Blower Wheel Size (Dia x W), in. [mm]	11 x 10 [279 x 254]	11 x 10 [279 x 254]	11 x 10 [279 x 254]	11 x 10 [279 x 254]
Coax and Water Piping				
Loop Water Connections Size - Swivel - in [mm]	1" [25.4]	1" [25.4]	1" [25.4]	1" [25.4]
Hydronic Water Connections Size - Swivel - in [mm]	1" [25.4]	1" [25.4]	1" [25.4]	1" [25.4]
HWG Connection Size - Swivel - in [mm]	1" [25.4]	1" [25.4]	1" [25.4]	1" [25.4]
Coax & Piping Water Volume - gal [l]	1.3 [4.9]	1.6 [6.1]	1.6 [6.1]	1.6 [6.1]
Vertical				
Air Coil Dimensions (H x W), in. [mm]	28 x 25 [711 x 635]	32 x 25 [813 x 635]	36 x 25 [914 x 635]	36 x 25 [914 x 635]
Air Coil Total Face Area, ft2 [m2]	4.9 [0.451]	5.6 [0.570]	6.3 [0.641]	6.3 [0.641]
Air Coil Tube Size, in [mm]	3/8 [9.5]	3/8 [9.5]	3/8 [9.5]	3/8 [9.5]
Air Coil Number of rows	3	3	4	4
Filter Standard - 2" [51mm] Pleated MERV11 Throwaway, in [mm]	28 x 30 [712 x 762]	32 x 30 [813 x 762]	36 x 30 [914 x 762]	36 x 30 [914 x 762]
Weight - Operating, lb [kg]	435	540	550	550
Weight - Packaged, lb [kg]	445	550	560	560

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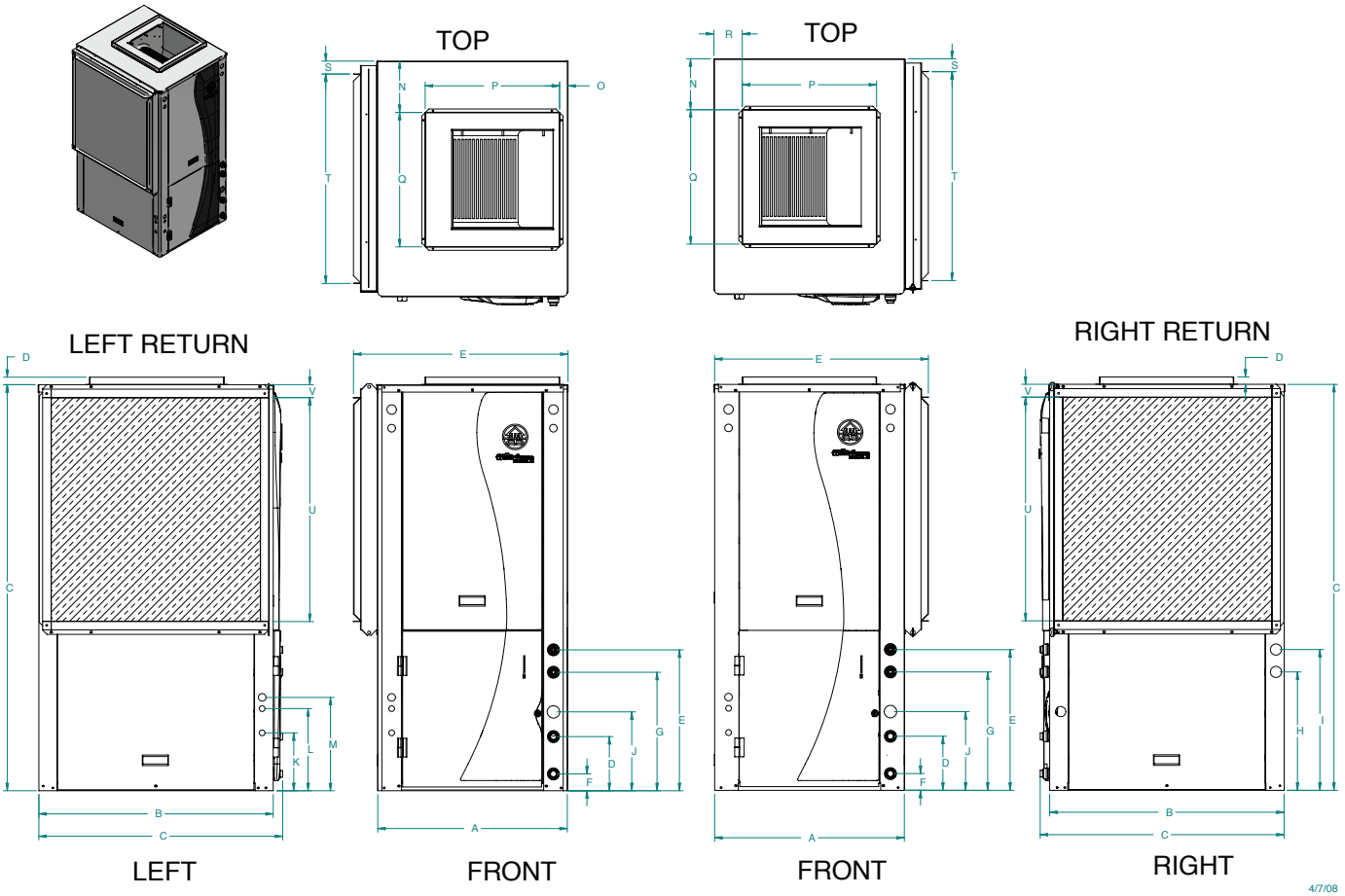
Dimensional Data



Vertical Topflow Model		Overall Cabinet			Water Connections										Electrical Connections			Discharge Connection duct flange installed (±0.10 in)					Return Connection using std deluxe filter rack (±0.10 in)			
		A	B	C	D	E	F	G	H	I	J	Loop	Hydronic	HWG	K	L	M	N	O	P	Q	R	S	T	U	V
		Width	Depth	Height	Loop In	Hydronic Out	Hydronic In	Loop Out	HWG In	HWG Out	Cond-ensate	Water FPT	Water FPT	FPT	1/2" cond Low Votage	1/2" cond Ext Pump	3/4" cond Power Supply			Supply Width	Supply Depth			Return Depth	Return Height	
038	in.	25.6	31.6	50.4	2.3	18.9	2.3	7.3	13.6	16.6	10.6	1" Swivel	1" Swivel	1" Swivel	8.0	11.3	12.8	6.9	1.1	18.0	18.0	3.8	1.7	28.1	26.0	1.7
	cm.	65.0	80.3	128.0	5.8	48.0	5.8	18.5	34.5	42.2	26.9				20.3	28.7	32.5	17.5	2.8	45.7	45.7	9.7	4.3	71.4	66.0	4.3
049	in.	25.6	31.6	54.4	2.3	18.9	2.3	7.3	15.9	48.9	10.6	1" Swivel	1" Swivel	1" Swivel	8.0	11.3	12.8	6.9	1.1	18.0	18.0	3.8	1.7	28.1	30.0	1.7
	cm.	65.0	80.3	138.2	5.8	48.0	5.8	18.5	40.4	124.2	26.9				20.3	28.7	32.5	17.5	2.8	45.7	45.7	9.7	4.3	71.4	76.2	4.3
064	in.	25.6	31.6	58.4	2.3	18.9	2.3	7.3	15.9	18.9	10.6	1" Swivel	1" Swivel	1" Swivel	8.0	11.3	12.8	6.9	1.1	18.0	18.0	3.8	1.7	28.1	34.0	1.7
	cm.	65.0	80.3	148.3	5.8	48.0	5.8	18.5	40.4	48.0	26.9				20.3	28.7	32.5	17.5	2.8	45.7	45.7	9.7	4.3	71.4	86.4	4.3
072	in.	25.6	31.6	58.4	2.3	18.9	2.3	7.3	15.9	18.9	10.6	1" Swivel	1" Swivel	1" Swivel	8.0	11.3	12.8	6.9	1.1	18.0	18.0	3.8	1.7	28.1	34.0	1.7
	cm.	65.0	80.3	148.3	5.8	48.0	5.8	18.5	40.4	48.0	26.9				20.3	28.7	32.5	17.5	2.8	45.7	45.7	9.7	4.3	71.4	86.4	4.3

Condensate is 3/4" PVC female glue socket and is switchable from side to front

Unit shipped with deluxe 2" (field adjustable to 1") duct collar/filter rack extending from unit 3.25" and is suitable for duct connection.

Discharge flange is field installed and extends 1" [25.4mm] from cabinet

Decorative molding and water connections extend 1.2" [30.5mm] beyond front of cabinet.

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Microprocessor Control Operation

Heating Operation

Heat, 1st Stage (Y1)

The fan motor is started on low speed immediately (PSC ON), the loop pump is energized 5 seconds after the “Y1” input is received, and the compressor is energized on low capacity 10 seconds after the “Y1” input. The fan is switched to medium speed 15 seconds after “Y1” input (ECM only). The hot water pump is cycled 30 seconds after the "Y1" input.

Heat, 2nd Stage (Y1,Y2) Dual Capacity Units

The second stage compressor will be activated 5 seconds after receiving a “Y2” input as long as the minimum first stage compressor run time of 1 minute has expired. The ECM blower changes from medium to high speed 15 seconds after the “Y2” input.

The Comfort Alert will delay the second stage compressor until 5 seconds after it receives a “Y2” from the board.

Heat, 3rd Stage (Y1,Y2,W) Dual Capacity Units

The hot water pump is de-energized which directs all heat to satisfy the thermostat. The 1st stage of resistance heat is energized 10 seconds after “W” input, and with continuous 3rd stage demand, the additional stages of resistance heat engage sequentially every 5 minutes.

Emergency Heat (W Only)

Low speed blower and damper output CR3 will be energized immediately after receiving (W only). The first stage auxiliary heater will be energized 10 seconds upon receiving a (W only) and the blower will shift to high speed 15 seconds after receiving a “W” only input. If the “W” input is not removed, the second, third, and fourth auxiliary heat outputs will stage on, one at a time, every two minutes.

Cooling Operation

Cool, 1st Stage (Y1,O)

The blower motor and hot water pump are started immediately, the loop pump(s) is energized 5 seconds after the “Y1” input is received. The compressor will be energized (on low capacity for Dual Capacity units) 10 seconds after the “Y1” input. The ECM blower will shift from low to medium speed 15 seconds after the “Y1” input (85% of medium speed if in dehumidification mode).

Cool, 2nd Stage (Y1, Y2, O) Dual Capacity Units

The second stage compressor will be activated 5 seconds after receiving a “Y2” input as long as the minimum first stage compressor run time of 1 minute has expired. The ECM blower changes to high speed 15 seconds after the “Y2” input (85% of high speed if in dehumidification mode). The Comfort Alert will delay the second stage compressor until 5 seconds after it receives a “Y2” from the board.

Hydronic Cooling Slave Signal (24 vac input on P6-pin 15 violet wire)

The Synergy3D control board must be operating in cooling mode (Y1 and O inputs) or the cooling slave signal is ignored. When “Y1”, and “O” inputs have been received and a cooling slave input from heating/cooling thermostat located in a hydronic heated/force air cooled zone are received the control will activate CR3 relay to open damper(s) which will allow for cooling to occur in zone. When cooling slave input (24VAC) signal is removed the control will turn off the CR3 relay output, if spring damper operation is selected, or active, the CR4 output if POPC damper operation is selected. This will close field installed damper(s) located in ductwork.

NOTE: The control will not operate in forced air cooling and hydronic water heating modes simultaneously.

Hot Water Operation

After a hot water input is received, the diverting valve, loop pump and hot water pump are turned on. Five seconds after hot water input is received the compressor is activated in second stage.

Fan (G Only)

The fan starts on low speed. Regardless of fan input (G) from thermostat, the fan will remain on low speed for 30 seconds at the end of each heating, cooling or emergency heat cycle.

Microprocessor Control Operation (cont.)

Lockout Conditions

During lockout mode the appropriate unit and thermostat lockout LEDs will illuminate. The compressor, loop pump, hot water pump and accessory outputs are de-energized. Unless the lockout is caused by an ECM2 low RPM fault, the fan will continue to run on low speed, and if the thermostat calls for heating 3rd stage, emergency heat operation will occur.

Lockout modes can be reset at the thermostat after a five-second waiting period, which restores normal operation but keeps the unit lockout LED illuminated. Comfort Alert lockouts can not be reset at the thermostat and will not be displayed on the thermostat. Interruption of power to the unit will reset a lockout without a waiting period and clear all lockout LEDs.

High Pressure

This lockout mode occurs when the normally closed safety switch is opened momentarily. >600 PSI

Low Pressure

This lockout mode occurs when the normally closed switch is opened for 30 continuous seconds. <40 PSI

Freeze Sensing (Water Flow)

This lockout mode occurs when the freeze thermistor temperature is at or below the selected freeze protection point (well 30°F or loop 15°F) for 30 continuous seconds.

Condensate Overflow

This lockout mode occurs when the condensate overflow level has been reached for 30 continuous seconds.

Fan RPM (ECM2)

The Synergy3D control board monitors fan RPM to sense if the fan is not operating. This lockout mode occurs if the fan RPM falls below the low RPM limit (100 RPM) for 30 continuous seconds.

Microprocessor Control Operation (cont.)

Airflow Selection DIP Switches (SW1)

See Fan Speed section on page 16.

Field Selection DIP Switches (SW2)

An “8-position” DIP switch package on the Synergy3D control allows the following field selectable options:

1-Service Test Mode

This DIP switch on the control allows field selection of “Normal” or “Test” operational modes. The test mode accelerates most timing functions 16 times to allow faster troubleshooting. Test mode also allows viewing the “current” status of the fault inputs on the LED display.

2-Freeze Sensing Setting (water flow)

This DIP switch allows field selection of freeze thermistor fault sensing temperatures for well water or antifreeze-protected earth loops.

3-Forced Air Heating/Hydronic

This DIP switch allows field selection of “Heating Forced Air Priority” or “Hydronic Priority”.

4-Forced Air Cooling/Hydronic

This DIP switch allows field selection of “Cooling” “Forced Air Priority” or “Hydronic Priority”.

5-Whole/Forced Air Zone

This DIP switch allows field selection option for constant fan. When whole house is selected CR3, relay will activate and open dampers. When forced air is selected a damper (s) located in the hydronically heated forced air cooled zone will not be opened.

6-Diagnostics-Inputs

This DIP switch allows viewing the inputs from the thermostat to the control board such as “Y1”, “O”, “G”, “W”, “SL1-In” on the LED display.

7-Diagnostics-Outputs

This DIP switch allows viewing the outputs from the control board such as compressor, diverting valve, reversing valve, blower, hot water pump, and loop pump on the LED display.

8-Thermostat Selection

Configures the control for a pulsed lockout signal (ComforTalk and FaultFlash thermostats) or continuous lockout signal.

Factory Setup DIP Switches (SW3)

A “5-position” DIP switch package on the Synergy3D control allows the following factory setup options:

1-Dual Capacity/Single Speed

2-POPC/Spring

This switch allows field selection of “Power Open, Power Closed” dampers or “Power Open, Spring Close” dampers.

3-No RPM / RPM

This DIP switch configures the control to monitor the RPM output of an ECM2 blower motor. When using a PSC blower motor, the control should be configured for no RPM sensing.

4 and 5-Over-ride Time

These switches are used in conjunction to determine the override timings for forced air and hydronic operation. See Override Selection table (page 10) for timings.

Operating Limits

Operating Limits	Cooling		Heating	
	(°F)	(°C)	(°F)	(°C)
Air Limits				
Min. Ambient Air	45	7.2	45	7.2
Rated Ambient Air	80	26.7	70	21.1
Max. Ambient Air	100	37.8	85	29.4
Min. Entering Air	50	10.0	40	4.4
Rated Entering Air db/wb	80.6/66.2	27/19	68	20.0
Max. Entering Air db/wb	110/83	43/28.3	80	26.7
Water Limits				
Min. Entering Water	30	-1.1	20	-6.7
Normal Entering Water	50-110	10-43.3	30-70	-1.1
Max. Entering Water	120	48.9	90	32.2

Notes:

Minimum/maximum limits are only for start-up conditions, and are meant for bringing the space up to occupancy temperature. Units are not designed to operate at the minimum/maximum conditions on a regular basis. The operating limits are dependant upon three primary factors: 1) water temperature, 2) return air temperature, and 3) ambient temperature. When any of the factors are at the minimum or maximum levels, the other two factors must be at the normal level for proper and reliable unit operation.

Correction Factor Tables

Part Load Air Flow Corrections

Airflow		Cooling				Heating		
CFM Per Ton of Clg	% of Nominal	Total Cap	Sens Cap	Power	Heat of Rej	Htg Cap	Power	Heat of Ext
240	60	0.922	0.778	0.956	0.924	0.943	1.239	0.879
275	69	0.944	0.830	0.962	0.944	0.958	1.161	0.914
300	75	0.957	0.866	0.968	0.958	0.968	1.115	0.937
325	81	0.970	0.900	0.974	0.970	0.977	1.075	0.956
350	88	0.982	0.933	0.981	0.980	0.985	1.042	0.972
375	94	0.991	0.968	0.991	0.991	0.993	1.018	0.988
400	**100**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
425	106	1.007	1.033	1.011	1.008	1.007	0.990	1.010
450	113	1.013	1.065	1.023	1.015	1.012	0.987	1.018
475	119	1.017	1.099	1.037	1.022	1.018	0.984	1.025
500	125	1.020	1.132	1.052	1.027	1.022	0.982	1.031
520	130	1.022	1.159	1.064	1.030	1.025	0.979	1.034

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Full Load Air Flow Corrections

Airflow		Cooling				Heating		
CFM Per Ton of Clg	% of Nominal	Total Cap	Sens Cap	Power	Heat of Rej	Htg Cap	Power	Heat of Ext
240	60	0.922	0.786	0.910	0.920	0.943	1.150	0.893
275	69	0.944	0.827	0.924	0.940	0.958	1.105	0.922
300	75	0.959	0.860	0.937	0.955	0.968	1.078	0.942
325	81	0.971	0.894	0.950	0.967	0.977	1.053	0.959
350	88	0.982	0.929	0.964	0.978	0.985	1.031	0.973
375	94	0.992	0.965	0.982	0.990	0.993	1.014	0.988
400	**100**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
425	106	1.007	1.034	1.020	1.010	1.007	0.990	1.011
450	113	1.012	1.065	1.042	1.018	1.013	0.983	1.020
475	119	1.017	1.093	1.066	1.026	1.018	0.980	1.028
500	125	1.019	1.117	1.092	1.033	1.023	0.978	1.034
520	130	1.020	1.132	1.113	1.038	1.026	0.975	1.038

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Cooling Capacity Corrections (Dual Capacity Full & Part Load)

Entering Air WB ºF	Total Clg Cap	Sensible Cooling Capacity Multipliers - Entering DB ºF										Power Input	Heat of Rejection
		60	65	70	75	**80**	80.6	85	90	95	100		
45	0.719	0.891	1.058	1.128	*	*	*	*	*	*	*	0.898	0.741
50	0.719	0.893	0.980	1.106	*	*	*	*	*	*	*	0.898	0.741
55	0.812	0.629	0.844	1.026	1.172	*	*	*	*	*	*	0.922	0.819
60	0.897			0.820	0.995	1.206	1.238	*	*	*	*	0.955	0.895
65	0.960			0.568	0.810	1.004	1.052	1.227	*	*	*	0.982	0.951
66.2	0.984			0.505	0.743	1.002	1.027	1.151	*	*	*	0.993	0.980
67	**1.000**			0.463	0.699	**1.000**	1.011	1.101	1.310	*	*	**1.000**	**1.000**
70	1.047				0.599	0.865	0.879	1.007	1.225	1.433	*	1.018	1.029
75	1.148					0.567	0.584	0.734	0.956	1.261	1.476	1.056	1.118

Note: * Sensible capacity equals total capacity at conditions shown.

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Heating Capacity Corrections (Dual Capacity Full & Part Load)

	Heating Corrections		
Ent Air DB °F	Htg Cap	Power	Heat of Ext
45	1.050	0.749	1.158
50	1.059	0.859	1.130
55	1.043	0.894	1.096
60	1.033	0.947	1.064
65	1.023	0.974	1.030
68	1.009	0.990	1.012
70	**1.000**	**1.000**	**1.000**
75	1.011	1.123	0.970
80	1.000	1.196	0.930

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Auxiliary Heat

Auxiliary Heat Electrical Data

Model	Supply Circuit	Heater Amps		Min Circuit Amp		Max Fuse (USA)		Max Fuse (CAN)		Max CKT BRK	
		208 V	240 V	208 V	240 V	208 V	240 V	208 V	240 V	208 V	240 V
EAL(H)10	Single	34.7	40	53.3	60	60	60	60	60	60	60
EAL(H)15	Single	52.0	60	75	85	80	90	80	90	70	100
	L1/L2	34.7	40	53.3	60	60	60	60	60	60	60
	L3/L4	17.3	20	21.7	25	25	25	25	25	20	30
EAL(H)20	Single	69.3	80	96.7	110	100	110	100	110	100	100
	L1/L2	34.7	40	53.3	60	60	60	60	60	60	60
	L3/L4	34.7	40	43.3	50	45	50	45	50	40	50

All heaters rated single phase 60 cycle and include unit fan load
All fuses type "D" time delay (or HACR circuit breaker in USA)

Auxiliary Heat Ratings

Model	KW		Stages	BTU/HR		Min CFM	Model Compatibility			
	208V	230V		208V	230V		038	049	064	072
EAL(H)10	7.2	9.6	2	24,600	32,700	1100	•	•	•	•
EAL(H)15	10.8	14.4	3	36,900	49,100	1250	•	•	•	•
EAL(H)20	14.4	19.2	4	49,200	65,500	1500			•	•

Notes: High fan tap setting must be above the minimum CFM for the heater selected.

Blower Performance Data

MODEL	MAX ESP	AIR FLOW DIP SWITCH SETTINGS											
		1	2	3	4	5	6	7	8	9	10	11	12
038	**0.50**	650	750 L	850	1000	**1100 M**	**1200**	**1300 H**	**1400**	**1500**			
038 w/1hp*	**0.75**	800 L	1000	**1100 M**	**1300 H**	**1500**	**1600**	1800					
049	**0.50**	650	800 L	900	1050	1150	**1250**	**1350 M**	**1450**	**1550 H**			
049 w/1hp*	**0.75**	800 L	900	1000	1200	**1400 M**	**1600 H**	**1700**	**1850**	2000	2200	2300	2400
064	**0.75**	800	950 L	1100	1300	**1500 M**	**1750**	**1950 H**	**2100**	**2300**			
072	**0.75**	800	950	1100 L	1300	**1500**	**1750 M**	**1950**	**2100 H**	**2300**			

Factory settings are at recommended L-M-H DIP switch locations

M-H settings MUST be located within boldface CFM range

Lowest and Highest DIP switch settings are assumed to be L and H respectively

CFM is controlled within ±5% up to the maximum ESP

Max ESP includes allowance for wet coil and standard filter

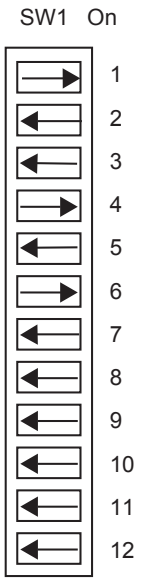
3/18/08

A 12-position DIP switch package on the Synergy3D control allows the airflow levels to be set for Low, Medium and High speed when using the ECM2 blower motor.

Only three of the DIP switches can be in the “On” position. The first “On” switch (the lowest position number) determines the “Low Speed Fan” setting. The second “On” switch determines the “Medium Speed Fan” setting, and the third “On” switch determines the “High Speed Fan” setting.

The example to the right shows SW1 on the Synergy3D control board configured for the following SDV049 airflow settings:

Low Speed Fan: 750 CFM
Medium Speed Fan: 1200 CFM
High Speed Fan: 1600 CFM



Startup

Before powering unit, check the following:

- Fuses, breakers and wire size are correct and match the name plate.
- Low voltage wiring is complete.
- Piping has been completed and the water system is cleaned and flushed.
- Air is purged from the closed loop system.
- Air is purged from buffer tank, hydronic system isolation valves are open, and water control valves or loop pumps are wired.
- Condensate line is open and correctly pitched.
- Black/white and gray/white wires in unit control box have been removed if auxiliary heat has been installed.
- DIP switches are set correctly.
- Blower rotates freely and foam shipping support has been removed.
- Blower speed is correct (DIP switch setting).
- Air filter is clean and in position.
- Service/access panels are in place.
- Return air temperature is between 60-80°F in heating and 70-95°F in cooling.
- Air coil is clean.

Forced Air Startup Instructions

NOTE: On initial power-up a four-minute time delay will occur.

1. Initiate a control signal to energize the blower motor. Check blower operation.
2. Initiate a control signal to place the unit in the cooling mode. Cooling setpoint must be set below room temperature.
3. First stage cooling will energize after a time delay.
4. Be sure that the compressor and water control valve or loop pumps are activated.
5. Verify that the water flow rate is correct by measuring the pressure drop through the heat exchanger using the P/T plugs and comparing to water pressure drop found in table on page 22.
6. Check the temperature of both the supply and discharge water. Refer to tables on page 22.
7. Check for an air temperature drop of 15° to 25° F across the air coil, depending on the fan speed and entering water temperature. See Typical Air Temperature Rise/Drop Chart (on page 22).
8. Adjust the cooling setpoint above the room temperature and verify that the compressor and water valve or loop pumps deactivate.
9. Initiate a control signal to place the unit in the heating mode. Heating setpoint must be set above room temperature.
10. First stage heating will energize after a time delay.
11. Check for an air temperature rise of 20° to 35° F across the air coil, depending on the fan speed and entering water temperature. Refer to typical Air Temperature Rise/Drop Chart on page 22.
12. If auxiliary electric heaters are installed, adjust the heating setpoint until the electric heat banks are sequenced on. All stages of the auxiliary heater should be sequenced on when the thermostat is in the “Emergency Heat” mode. Check amperage of each element.
13. Adjust the heating setpoint below room temperature and verify that the compressor and water valve or loop pumps deactivate.
14. During all testing, check for excessive vibration, noise or water leaks. Correct or repair as required.
15. Set system to desired normal operating mode and set temperature to maintain desired comfort level.
16. Instruct the owner/operator in the proper operation of the thermostat and system maintenance.

Synergy3D Startup and Troubleshooting Form

Company Name: _____ Company Phone No: _____
Technician Name: _____ Date: _____
Synergy3 Model No: _____ Serial No: _____
Ownerís Name: _____ Open or Closed Loop: _____
Installation Address: _____ Installation Date: _____

Check One
❑ Start up/Check-out for new installation ❑ Troubleshooting Problem: _____

1. FLOW RATE IN GPM (SOURCE SIDE HEAT EXCHANGER)

Water In Pressure:	a._____	PSI
Water Out Pressure:	b._____	PSI
Pressure Drop = a - b	c._____	PSI
Convert Pressure Drop to Flow Rate (refer to installation manual page 32)	d._____	GPM

2. TEMPERATURE RISE OR DROP ACROSS SOURCE SIDE HEAT EXCHANGER

	COOLING		HEATING	
Water In Temperature:	e._____	°F	e._____	°F
Water Out Temperature:	f. _____	°F	f. _____	°F
Temperature Difference:	g._____	°F	g._____	°F

3. TEMPERATURE RISE OR DROP ACROSS AIR COIL

	COOLING		HEATING	
Supply Air Temperature:	h._____	°F	h._____	°F
Return Air Temperature:	i. _____	°F	i. _____	°F
Temperature Difference:	j. _____	°F	j. _____	°F

4. HEAT OF REJECTION (HR) / HEAT OF EXTRACTION (HE) CALCULATION

HR or HE = Flow Rate x Temperature Difference x Brine Factor*
d. (above) x g. (above) x 485 for Methanol or Environol, 500 for water*

Heat of Extraction (Heating Mode) =	_____	btu/hr
Heat of Rejection (Cooling Mode) =	_____	btu/hr

Compare results to Capacity Data Tables

Note: Steps 5 through 8 need only be completed if a problem is suspected

5. WATTS

	COOLING		HEATING		HYDRONIC	
Volts:	m._____	VOLTS	m._____	VOLTS	m. _____	VOLTS
Total Amps (Comp. + Fan):	n. _____	AMPS	n. _____	AMPS	n. _____	AMPS
Watts = m. x n. x 0.85	o. _____	WATTS	o. _____	WATTS	o. _____	WATTS

6. CAPACITY

Cooling Capacity = HR. - (o. x 3.413)	p. _____	btu/hr
Heating Capacity= HE. + (o. x 3.413)	p. _____	btu/hr

7. EFFICIENCY

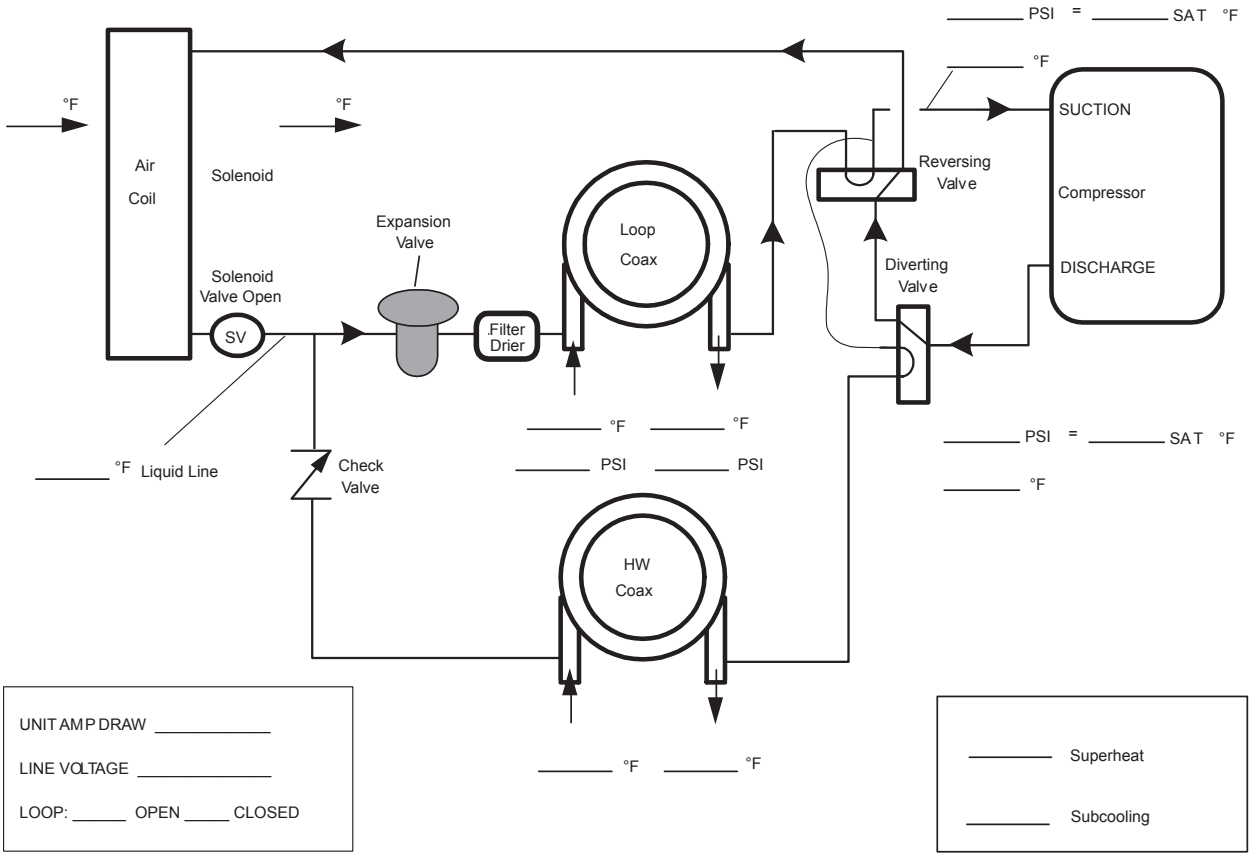
Cooling EER = p. / o.	q. _____	EER
Heating COP = p. / (o. x 3.413)	q. _____	COP

8. SUPERHEAT (S.H.) / SUBCOOLING (S.C.)

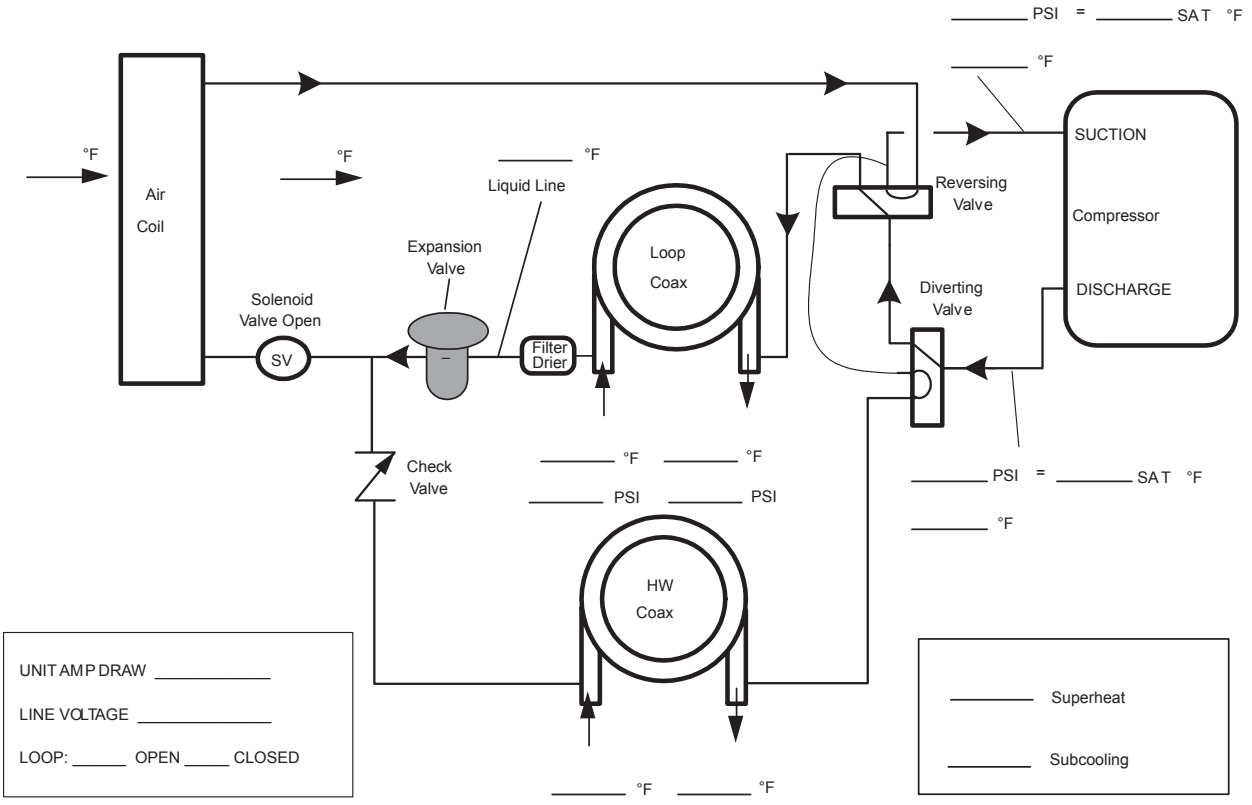
COOLING			HEATING		HYDRONIC	
Suction Pressure:	r. _____	PSI	r. _____	PSI	r. _____	PSI
Suction Saturation Temperature:	s. _____	°F	s. _____	°F	s. _____	°F
Suction Line Temperature:	t. _____	°F	t. _____	°F	t. _____	°F
Superheat = t. - s.	u. _____	°F	u. _____	°F	u. _____	°F
Head Pressure:	v. _____	PSI	v. _____	PSI	v. _____	PSI
High Pressure Saturation Temp.:	w. _____	°F	w. _____	°F	w. _____	°F
Liquid Line Temperature*:	x. _____	°F	x. _____	°F	x. _____	°F
Subcooling = w. - x.	y. _____	°F	y. _____	°F	y. _____	°F

* Note: Liquid line is between the source coax and the expansion valve in the cooling mode; between the air coil and the expansion valve in the heating mode; between hot water (load) coax and txv in hot water mode.

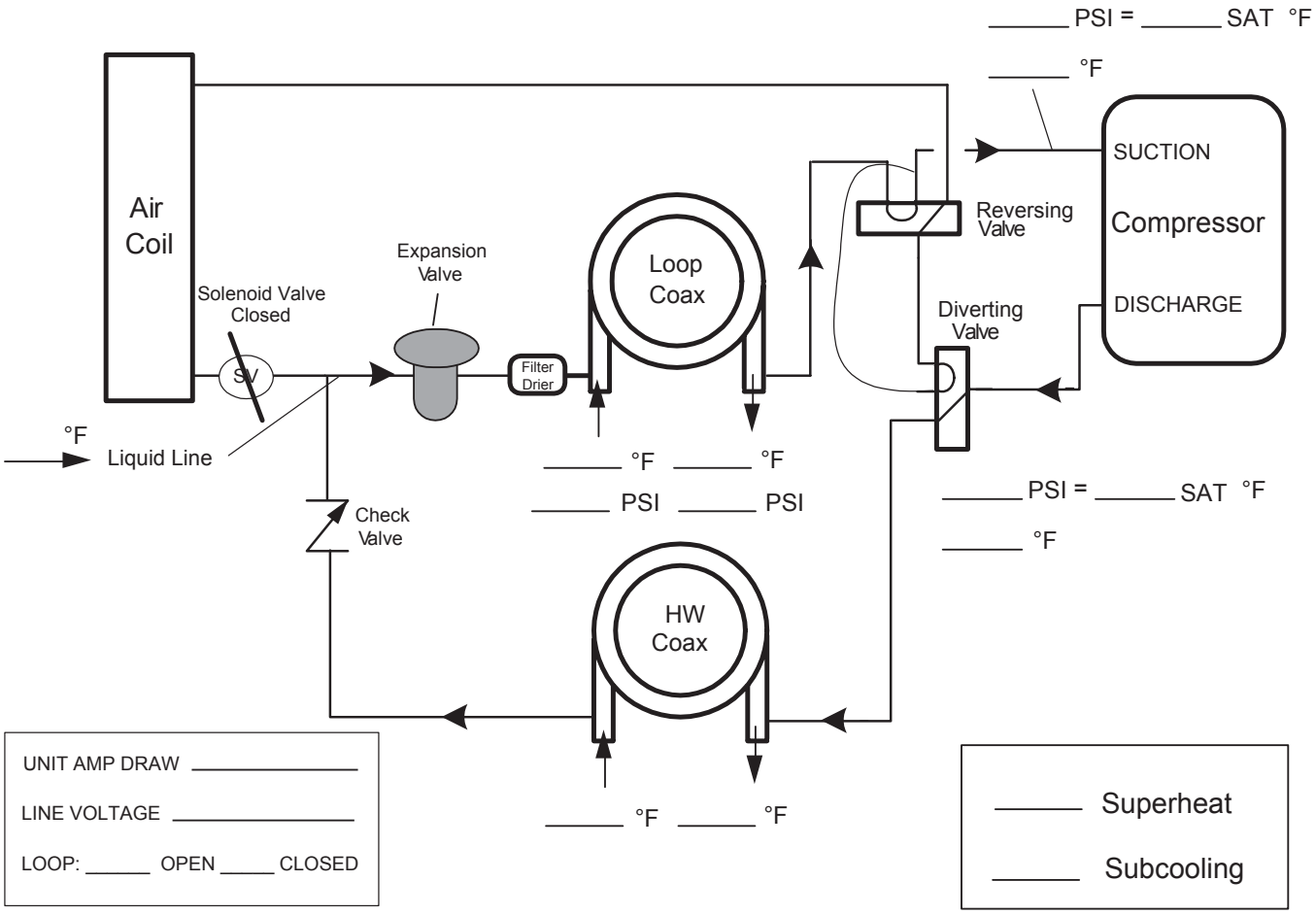
Synergy3D Heating Cycle Analysis



Synergy3D Cooling Cycle Analysis



Synergy3D Hot Water Cycle Analysis



NOTE: Do not attach refrigerant gauges unless a problem is suspected!

Installation Notes

Manufactured by
WaterFurnace International, Inc.
9000 Conservation Way
Fort Wayne, IN 46809
www.waterfurnace.com

Product:	**Synergy3D**
Type:	Geothermal Heat Pumps with Water Heating for Radiant Floor Applications
Size:	3 thru 6 Ton
Document:	Installation Manual

IM1602 04/08

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